

REMARKS/ARGUMENTS

Introduction:

Claims 2-54 have been amended, and claims 55-62 have been added. Claims 2-62 are now pending in the application. Applicant respectfully requests reconsideration of the application.

Priority:

The assertion in the Office Action that the claims reciting "computer-readable media" are not entitled to the filing date of the parent application appears to be based on the assertion that the parent application does not provide proper antecedent basis for the term "computer-readable media." Applicant traverses the PTO's refusal to grant priority, as support for the claim term "computer-readable media" is provided by the parent application as discussed below.

Specification:

The Office Action objected to the specification as failing to provide antecedent basis for the claimed term "computer-readable media." Applicant respectfully traverses the objection, as *literal* support for claim terms is **not** required by 37 CFR § 1.75(d)(1). As stated in 37 CFR 1.75(d)(1), "the terms and phrases used in the claims must find clear support or antecedent basis in the description" (emphasis added) (see also MPEP § 2106(V)(B)(I), which states "the claimed inventive subject matter need not be described literally, i.e., using the same terms, in order for the disclosure to satisfy the description requirement. Software aspects of inventions, for example, may be described functionally.").

The claimed terms "computer-readable media" and "computer program product" are supported by both the present application and the parent application. These terms are well known in the computer field, and a person of ordinary skill in the field would instantly know that these terms include memory devices, magnetic disks, optically readable disks (e.g., compact disks and digital video disks), and the like. Moreover, the parent application states that embodiments of the invention "may be implemented in software operating on a general or special purpose computer" (paragraph 123 of the published version of the originally filed application serial no. 09/ 938,789). A person of ordinary skill in the computer field would instantly know that software cannot run on a computer unless the software is stored at least

temporarily in a "computer-readable media" or "computer program product"; otherwise, as a person of ordinary skill in the field would know, the software would not be accessible to the computer and thus could not run on the computer. A person of ordinary skill in the field would thus instantly recognize that embodiments of the invention described in the specification can be stored on a computer readable media and run on a computer. Thus, the meaning of the terms "computer-readable media" and "computer program product" are well known, and their presence in the parent application is readily ascertainable from the above quoted sentence from the parent application. Moreover, computer readable media and computer program product on which software can be stored are so pervasively known in the field that a person of ordinary skill in the field would have no trouble making and using such computer readable media and computer program product. Therefore, the parent application provides proper antecedent basis for the terms "computer-readable media" and "computer program product" and the terms are fully supported and enabled by the parent application.

Claim Objections:

Claims 49-54 were objected to due to a minor error. Claims 49-54 have amended to correct the error. No new matter is added by this amendment, as the error and necessary correction would be readily recognized by one of ordinary skill in the art.

Double Patenting:

In response to the double patenting rejection, Applicant will file a terminal disclaimer after all other issues in the application are resolved. To clarify the record, however, Applicant note that, as stated in the Office Action, "the conflicting claims are not identical." It necessarily follows that the claims in US Patent No. 6,678,876 do not "anticipate" the claims pending in this application.

Rejections under 35 U.S.C. § 101:

Claims 2-54 were rejected under 35 U.S.C. § 101 as being non-statutory subject matter. The Office Action states that "the claimed invention would impermissibly cover every substantial practical application of, and thereby preempt all use of the equation of the routing

algorithm.” Applicant respectfully traverses the rejection, as the stated grounds of rejection do not correctly state current law or USPTO rules of examination.

Computer-related inventions are examined for patentability under 35 U.S.C. § 101 according to MPEP § 2106. “If the record as a whole suggests that it is more likely than not that the claimed invention would be considered a practical application of an abstract idea, natural phenomenon, or law of nature, then USPTO personnel should not reject the claim.” MPEP §2106(IV)(D). When the record as a whole is considered, the present application provides substantial examples showing that the claimed invention has a practical application. In particular, independent claims 2, 12 and 18 call out a computer having additional specific features directed to routing. Independent claims 22, 32 and 39 call out a computer readable media having software for causing the computer to perform a method for finding a path within a routing space and having additional specific features directed to routing. Dependent claims 43, 45, 47, 49, 51, and 53 provide additional features of embodiments of the invention related to routing paths for a trace or wiring in an electronics system. For the foregoing reasons and the reasons discussed in the previous Amendment and Response submitted on April 2, 2007, the present claims are directed to practical applications that have useful, concrete, and tangible results, and the claims thus pass statutory muster under 35 USC 101. (See, e.g., MPEP 2106(C)(2) (a claimed invention is directed to a practical application when it produces a useful, concrete and tangible result)).

Moreover, the Office Action seems to premise the rejection on the assertion that the claims would preempt “*the equation* of the routing algorithm” (emphasis added). Applicant notes that none of the claims recite “an equation,” and therefore a rejection based on an assertion that the claims would preempt an equation is improper. Certainly, the claims do not recite a “mathematical equation,” and Applicant respectfully asserts that the only type of equation that can give rise to a rejection under 35 USC 101 is a “mathematical equation.” Should the PTO persist in this rejection, Applicant requests that the PTO identify the equation allegedly recited in the claims and explain—asserting proper PTO authority such as the MPEP or case law—why such an equation is a “mathematical equation.” If the PTO does not assert that the equation is a mathematical equation, Applicant requests that the PTO assert authority by reference to the MPEP or a court case that such an equation cannot be covered by a patent claim.

Accordingly, for at least the reasons cited above, withdrawal of the rejections under 35 U.S.C. 101 is hereby requested.

Rejections under 35 U.S.C. 102:

Claims 2-54 were rejected under 35 U.S.C. 102(e) as being anticipated by Vaughn (U.S. Publication No. 2001/0038612). Applicant respectfully traverses the rejection.

Before addressing the rejections in detail, the following summary may prove helpful. While the following summary discusses examples of some embodiments of the present invention, it will be appreciated the invention is not limited to this summary. That is, the following summary is not provided by way of limitation—and indeed refers generally to exemplary embodiments of the invention rather than the inventions recited in the claims—but is provided by way of background.

Some embodiments of the present invention can provide automatic (e.g., computer implemented) routing of traces or wiring within an electronics systems (see paragraph 22 of the parent application; all paragraph references are to the parent application serial no. 09/938,789). A routing area (e.g., representing a printed circuit board having components mounted thereon) can be represented by a routing space (para 25). Two different aspects of performing routing are described within the present application: creating an array of nodes within the routing space, and determining a path through the array of nodes.

In the first aspect, an initial array of nodes can be defined within the routing space (para 28), and the initial array of nodes can be adjusted in relation, for example, to pairs of obstacles (e.g., components) (para 34). Adjusting the array of nodes effectively can take into account the presence of the obstacles and design rule constraints (see para 34). Various detailed examples of techniques for adjusting the array of nodes are disclosed (para 34 – 67). The adjusted array of node can be linked together, so that each link represents a possible portion of a route for a trace (para 68). In other words, the linked nodes can represent potential routing paths between nodes for traces (para 80). Once the nodes have been created, traces can be routed (para 83). Thus, it should be appreciated that the initial creation and adjustment of nodes can be performed relative to obstacles, and in some embodiments, does not require use of a net list of traces that will be routed.

In the second aspect, the adjusted array of nodes can be used for routing traces (para 84). Routing can start from a source node, and then can find nodes to which the source node can be linked (para 86). Multiple paths can be iteratively extended through the adjusted array of nodes, and routing costs can be estimated for each path (para 95). As paths merge, higher costs paths can be deleted (para 102). The process can be repeated until the destination node is reached (para 109). Accordingly, multiple paths can be iteratively advanced through the adjusted array of nodes, until a source to destination connection is defined. Thus, it should be appreciated that, in some embodiments, the selection of paths can use the net list and the adjusted array of nodes, and does not require making reference to the locations of obstacles.

Thus, the present techniques can, in some embodiments, accommodate obstacles and design constraints within an adjusted array of nodes (e.g., a routing grid). Linking the adjusted array of nodes together can effectively determine all possible routing paths, while taking into account the constraints imposed by obstacles and design rules. The adjusted array of nodes can then be used for routing path selection using a routing cost function. Note that creating the adjusted array of nodes can be performed independently of the selection of paths through the adjusted array of nodes (para 116).

In contrast, Vaughn teaches a routing approach which must start from a net list that defines an order of nodes or end points of the paths to be routed (publication 2001/0038612, para 67). In Vaughn, the term “node” is used differently, as Vaughn defines a node as “a connection of a trace at a terminal or a target” (para 89) and thus ties all nodes to a particular trace. Routing consist of first connecting the nodes (traces) “without regard to crowding or angles” (para 104). A minimum spanning tree analysis simply selects a shortest path between the nodes, and this is performed without consideration for obstacles and routing density, as further calculations are later performed to address these constraints (para 106, 107). The connections are resolved into horizontal and vertical paths (para 106), and then density is calculated and traces moved from high density to low density regions (para 106-107). Vaughn accordingly teaches accommodating obstacles and design constraints (e.g. routing density) only later while determining the routing paths.

Now, turning to the rejections in detail, the following specific distinctions between the present claims and Vaughn are noted:

Claim 2-11, 43 and 44

Applicant respectfully traverses the rejection of claims 2-11, 43 and 44 as Vaughn fails to teach every element of the claimed invention.

Independent claim 2 recites “means for adjusting said initial array of nodes ... between at least a pair of obstacles.” At the cited section, Vaughn describes routing a trace “around obstacles” (para 68, lines 15-18) but fails to make any mention of adjusting a node, much less adjusting an array of nodes as claimed. A trace is simply not the same thing as a node. Moreover, claim 2 provides advantages over Vaughn. For example, because claim 2 first creates and then adjusts an array of nodes that can represent points through which a path can be routed and thereafter routes the path through the nodes, the subject matter of claim 2 can create paths more efficiently and effectively than Vaughn, which as mentioned, manipulates traces—not nodes.

Claim 2 also recites “means for selecting a path through said adjusted array of nodes.” The cited section of Vaughn describes routing being performed on zones (para 68, lines 18-21), and says nothing about selecting a path *through an array* of nodes. As noted above, paths in Vaughn are created as point-to-point links, and then adjusted for obstacles or density considerations: therefore no selection of paths through nodes is described in Vaughn (para 104-107).

Accordingly, for at least these reasons, claim 2 is allowable over Vaughn. Claims 3-11, 43 and 44, being dependent from claim 2, are also allowable for at least the above reasons.

Claim 3

In addition to the above reasons, claim 3 is also allowable because Vaughn fails to teach the recited feature of “means for determining a number of paths that may pass between said pair of obstacles.” The cited section of Vaughn merely describes performing routing within a defined zone quanta of limited area, and that the reduced size reduces the number of obstacles to be processed (para 157, lines 8-13). This falls short of teaching the recited feature of determining a *number* of paths.

Claim 4

In addition to the above reasons, claim 4 is also allowable over Vaughn because Vaughn fails to teach the recited feature of “means ... determines a number of paths that may cross a line segment between said pair of obstacles.” The cited section of Vaughn is merely a discussion of density measurements (para 108, lines 1-8), but makes no mention of determining a number of paths as claimed.

Claim 5

In addition to the above reasons, claim 5 is also allowable over Vaughn because Vaughn fails to teach the recited feature wherein “adjusting means adjusts a number of nodes ... between said pair of obstacles.” The cited section of Vaughn is merely a discussion of moving orthogonal segment paths to adjust density (para 109), but makes no mention of adjusting a number of nodes, or adjusting nodes relative to obstacles as claimed.

Claim 6

In addition to the above reasons, claim 6 is also allowable over Vaughn because Vaughn fails to teach the recited feature wherein “adjusting means adjusts locations of said nodes located between said pair of obstacles.” The cited section of Vaughn is merely a discussion of adding nodes to path segments where the path segment is jogged or changed in direction (para 182, lines 7-10). In contrast to Vaughn’s teaching of adding nodes, the features recited in claim 6 include “adjusting.” Adding a new node is distinctly different than adjusting an existing node.

Claim 8

In addition to the above reasons, claim 8 is also allowable over Vaughn because Vaughn fails to teach the recited feature “wherein said adjusting means adjusts a location of each of at least one of said nodes in accordance with a proximity of said node to an object.” The cited section of Vaughn (para 67, lines 9-13) provides no mention of adjusting a node location in accordance with a *proximity* to an object.

Claim 9

In addition to the above reasons, claim 9 is also allowable over Vaughn because Vaughn fails to teach the recited feature of “linking means for linking said adjusted initial array of

nodes.” The cited section of Vaughn describes connecting routing segments (para 162, lines 1-6), not linking *nodes* as claimed. Routing segments are different than nodes.

Claim 10

In addition to the above reasons, claim 10 is also allowable over Vaughn because Vaughn fails to teach the recited feature wherein “said linking means creates a link between each node in said array and nodes within a predetermined proximity of said each node.” The cited section of Vaughn describes connecting nodes in the net list (para 104, lines 5-6). In contrast, the presently claimed nodes are “within a routing space” (see claim 1). A routing space is distinct from a net list. As is known, a routing space can be an area through which actual connections between elements of a circuit are created; in contrast, a net list merely identifies which elements in the circuit are connected. Furthermore, in the cited section (para 104, lines 5-6), Vaughn fails to make any mention of proximity or forming a link for nodes based on a proximity as claimed.

Claim 11

In addition to the above reasons, claim 11 is also allowable over Vaughn because Vaughn fails to teach the recited feature wherein “said path traverses ones of said links.” The cited section of Vaughn (para 163, lines 10-15) provides no teachings relative to paths traversing links between nodes in an adjusted initial array of nodes.

Claims 12-17, 45 and 46

Applicant respectfully traverses the rejection of claims 12-17, 45 and 46 as Vaughn fails to teach every element of the claimed invention.

Independent claim 12 recites “means for determining a path ... through said linked nodes.” As noted above, within Vaughn, nodes are related to the path segments, and not “an array of linked nodes” as presently claimed.

In particular, claim 12 recites “creating ... partial paths,” “determining a routing cost of each said partial path,” and “discarding all of said partial paths that extend to one intermediate node except the partial path with the lowest routing cost.” In contrast, the process described by Vaughn uses “point-to-point connections” between the terminals in the net list (para 112, lines 2-6), and thus does not correspond to *partial* paths as claimed. In particular, Vaughn considers

connections between nodes *in the net list* (para 112, lines 1-5). In contrast, the present claim refers to partial paths “extending to an intermediate node,” the intermediate node being in “the array of linked nodes within *said routing space*.” Again, as noted above, a routing space is distinct and different from a net list.

Claim 12 also recites determining “a routing cost.” The minimum spanning tree analysis of Vaughn finds the shortest “possible path” for the point to point connections that connect the multiple nodes together (para 113, lines 9-13). Vaughn's MST calculation uses the length of the point-to-point links, however, and therefore does not take into account actual routing distances (see FIG. 5). Thus, Vaughn's “shortest possible path” is a theoretical measure and does not represent a *routing cost*, as presently claimed. Routing in Vaughn includes orthogonalizing the point-to-point links obtained from the MST analysis (para 114, lines 9-10) and thus the segment length actually routed differ from the lengths obtained in the MST analysis (see also para 115, stating “minimum spanning tree analysis is performed on the connection information *from the net list*”).

Accordingly, for at least these reasons, claim 12 is allowable over Vaughn. Claims 13-17, 45 and 46, being dependent from claim 12, are also allowable for at least the above reasons.

Claim 15

In addition to the above reasons, claim 15 is also allowable over Vaughn because Vaughn fails to teach the recited feature wherein “said means for providing further comprises... means for creating a link between said each node and nodes within a predetermined proximity of said each node.” The cited section of Vaughn (para 104, lines 5-6) merely describes connections *in a net list* and provides no teachings relative to linking nodes within an array of nodes *within a routing space*.” The cited section also fails to make any mention of proximity. See also discussion above related to claims 2, 8, and 10.

Claim 17

In addition to the above reasons, claim 17 is also allowable over Vaughn because Vaughn fails to teach the recited feature wherein “said means for providing further comprises... means for creating a link to another node of said array that is within a predetermined distance.” The cited section of Vaughn (para 113) merely describes connections *in a net list* and provides no

teachings relative to linking nodes within an array of nodes *within a routing space*” or linking based on “proximity” as claimed. See also discussion above related to claims 2, 8, and 10.

Claims 18-21, 47 and 48

Independent claim 18 contains similar features as claim 2, and is therefore allowable for at least the above reasons. Claims 19-21, 47 and 48, being dependent from claim 18, are therefore also allowable for at least the reasons cited for claim 18, as well as additional reasons discussed above for dependent claims having similar features.

Claim 19

In addition to the above reasons, claim 19 is also allowable for the reasons that Vaughn provides no teachings related to “means for applying a force to said node.” The cited section of Vaughn (para 170; FIG. 13C) describes determining whether an obstacle has been bypassed during routing, but makes no mention of “applying a force” or anything analogous.

Claim 21

Claim 21 includes similar features as claim 19, and is therefore also allowable for at least this additional reason.

Claims 22-31, 49 and 50

Independent claim 22 contains similar features as claim 2, and is therefore allowable for at least the above reasons. Claims 23-31, 49 and 50, being dependent from claim 2, are therefore also allowable for at least the reasons cited for claim 2, as well as additional reasons for dependent claims discussed above having similar features.

Claims 32-38, 51 and 52

Independent claim 32 contains similar features as claim 12, and is therefore allowable for at least the above reasons. Claims 33-38, 51 and 52, being dependent from claim 32, are therefore also allowable for at least the reasons cited for claim 12, as well as additional reasons for dependent claims discussed above having similar features.

Claims 39-42, 53 and 54

Independent claim 39 contains similar features as claim 2, and is therefore allowable for at least the above reasons. Claims 40-42, 54 and 54, being dependent from claim 2, are therefore also allowable for at least the reasons cited for claim 2, as well as additional reasons for dependent claims discussed above having similar features.

New Claims:

New claims 55-62 are herein presented. Claims 55, 57, 59 and 61 contain features related to forming a honeycombed pattern. Support for these claims is provided in the parent application at least at paragraph 28 and FIG. 5. Claims 56, 58, 60 and 62 contain features related to selecting a random location for at least one node. Support for these claims is provided in the parent application at least at paragraph 31.

Conclusion:

In view of the foregoing, Applicant submits that all of the claims are allowable and the application is in condition for allowance. If at any time the Examiner believes that a discussion with Applicant's attorney would be helpful, the Examiner is invited to contact the undersigned at (801) 426-2100.

Eight claims were added, making additional claim fees due. These fees, along with the fees for the Petition For Extension Of Time and the Request for Continued Examination are being submitted electronically herewith.

Respectfully submitted,

Date: October 31, 2007

By /William T. Ralston/
William T. Ralston
Reg. No. 55,561

Kirton & McConkie
P.O. Box 45120
Salt Lake City, Utah 84145-0120
Telephone: (801) 426-2100
Fax: (801) 321-4893